H-Genie® Lite
High Pressure Hydrogen Generator

User Manual
Version-1.0

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1. General Description

1.1 Introduction

The use of hydrogen gas in chemistry is limited due to the hazards associated with utilizing compressed gas cylinders. The H-Genie® Lite is designed to overcome these hazards, while also helping chemists with their chemistry.

The main features include:

- On-demand generation of 3.0 purity hydrogen (at room temperature) from water to make use of hydrogen gas safer.
- A pressure range of 1-50 bar (14.5-725 psi) to expand your chemistry capabilities.

1.2 H-Genie® Lite System Overview

The H-Genie® Lite hydrogen generator works by generating hydrogen gas up to 3.0 purity from deionized water using a patented electrolytic cell. The humidity of the hydrogen gas is reduced to meet the 3.0 gas quality requirement. The H-Genie® Lite generates hydrogen gas to the required pressure (up to 50 bar) by continuously generating hydrogen until this pressure is reached.

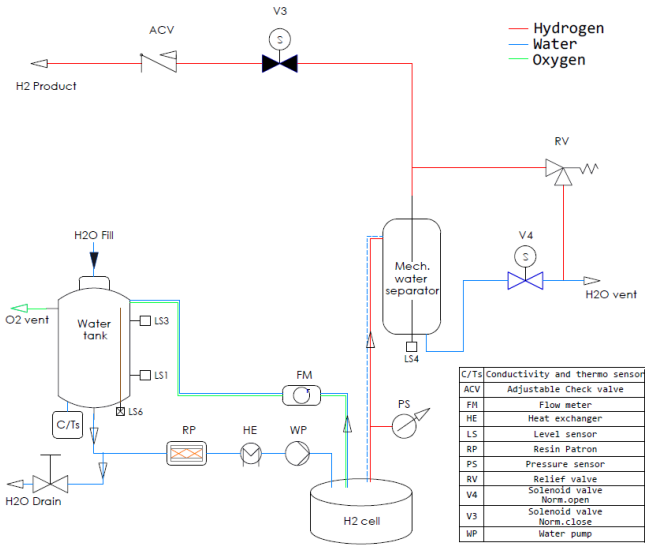

Figure 1: Schematic design of the H-Genie® Lite

2. Overview of Parts

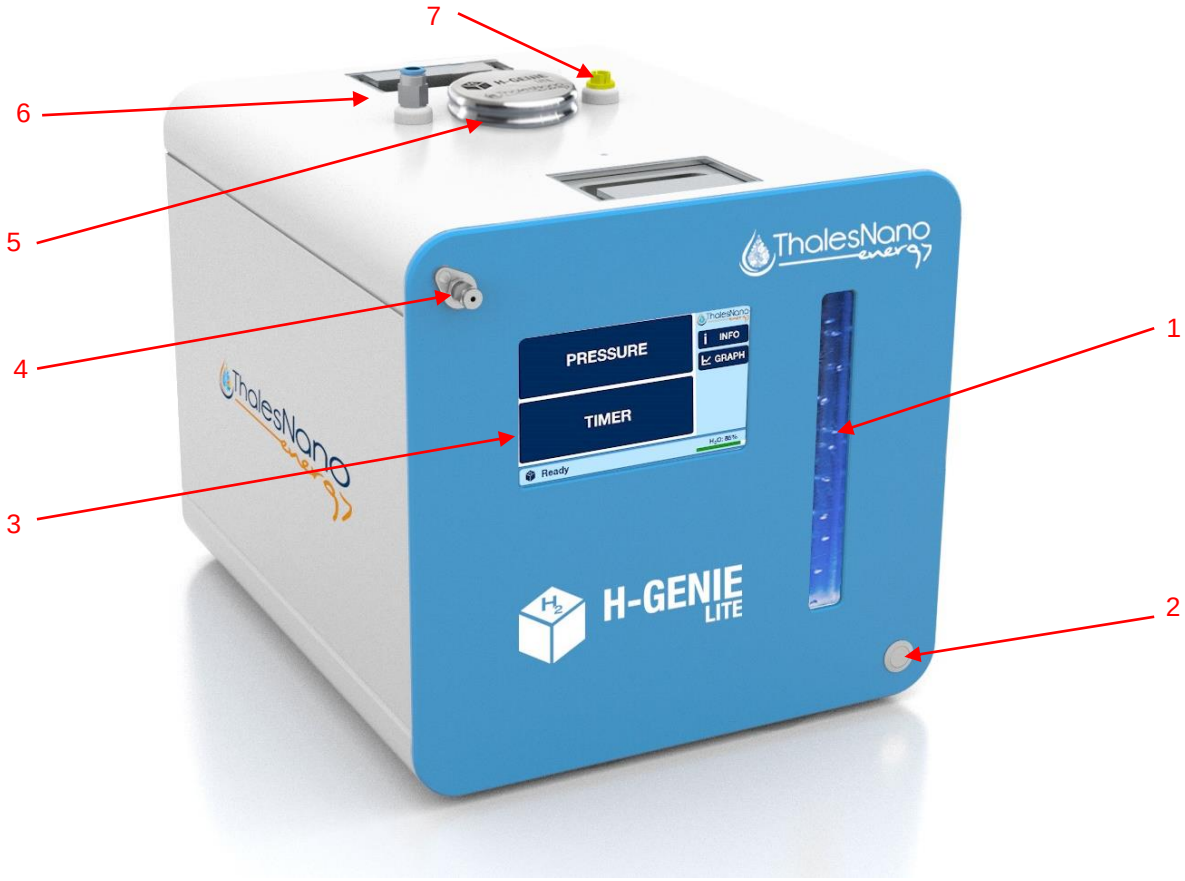

Figure 2: Front view of H-Genie® Lite

1. Air bubble tank decoration
2. On/off button
3. Touch-screen
4. Hydrogen gas outlet
5. Water tank cap
6. Oxygen gas outlet
7. Automated water filler port

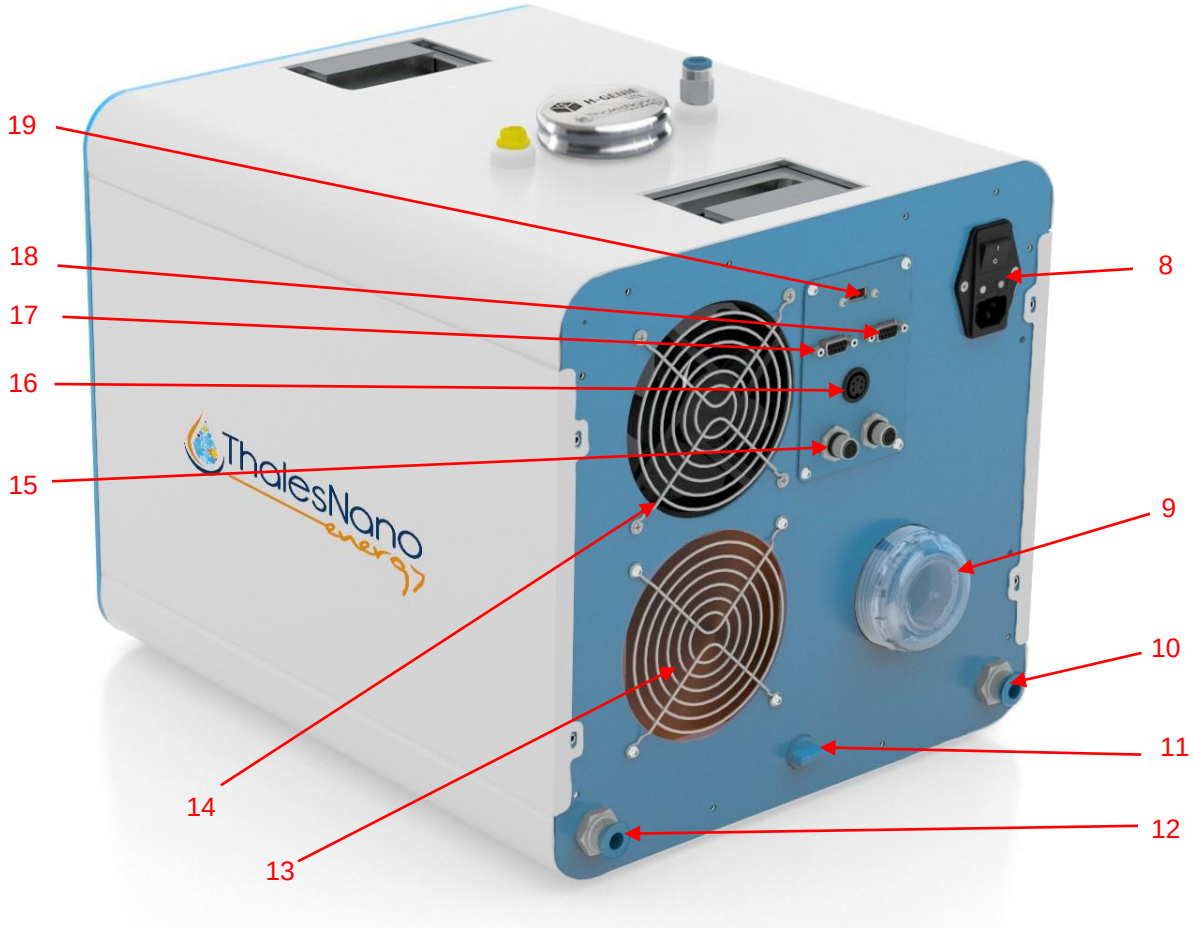

Figure 3: Rear view of H-Genie® Lite

8. Main ON/OFF switch, power cable and fuse sockets
9. Water purifier cartridge
10. Water vent
11. Water drain open-close hand operated ball valve (horizontally-open, vertically-closed)
12. Water drain outlet
13. Cooling vent (1 of 2)
14. Cooling vent (2 of 2)
15. External CAN connector sockets (for service purposes only; max cable length 3m)
16. Emergency Stop button connector socket (must use original THSE device)
17. RS-232 remote port (galvanically decoupled, max cable length 3m)
18. Service port: service-diagnostic connector; access for ThalesNano Energy authorised person only
19. USB port

2.1 Touch-screen Interface

The touch-screen interface consists of a series of windows that enable you to manually control all aspects of operation.

After turning on the equipment, the main window features a number of different options.

Figure 4: The Main screen

From the main screen you can choose two different options to start operation:

- Pressure: To supply hydrogen, up to a specific pressure, to any vessel, e.g.: a batch reactor.
- Timer: To supply hydrogen for specified period of time, e.g.: filling a balloon.

There are also other options available:

- Info Screen: Displays technical information and data about the H-Genie® Lite. The Info Screen may be accessed from any screen and under any status by pressing the “Info” button:

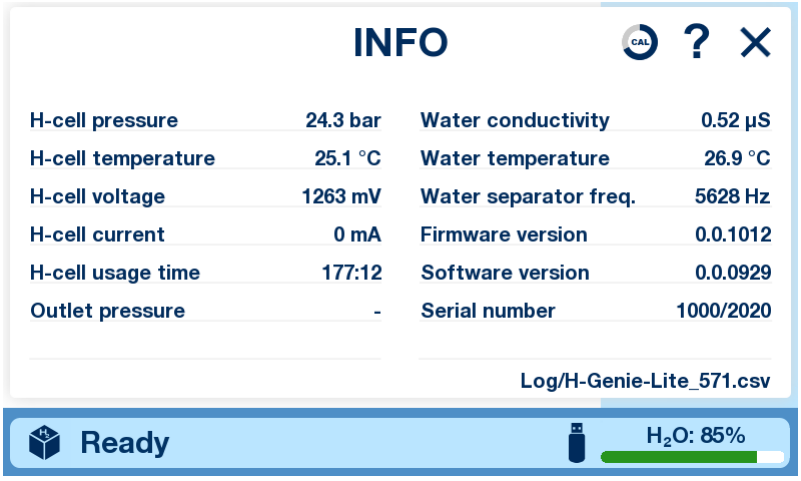

Figure 5: Info Screen

The information displayed is as follows:

- H-cell pressure: The pressure of hydrogen inside the H-Genie® Lite.
- H-cell temperature: The temperature of hydrogen cell
- H-cell voltage: Cell voltage measured in milli-volts.
- H-cell current: Cell current in milli-amperes.
- H-cell usage time: The hydrogen cell usage time measured in hours and minutes.
- Output pressure: The pressure of hydrogen leaving the H-Genie® Lite.
- Water conductivity: States the purity of the water in the H-Genie® Lite in µS/cm. The water conductivity MUST be below 1 µS/cm. The H-Genie® Lite will not function if the water conductivity is higher than 5 µS/cm.
- Water separator freq.: The measured water level frequency of the water separator of the H-Genie® Lite
- Water temperature: feed water temperature of the H-Genie® Lite
- Firmware version: The actual firmware version of the H-Genie® Lite
- Software version: The actual software version of the H-Genie® Lite
- Serial number: serial number of the H-Genie® Lite

Most of the measured system parameters are logged continuously internally. To export all files you can use the “export to USB drive” function located on the status bar in Info screen. Based on the status of the device three different icons could be displayed:

-  When the “USB drive is available” symbol is pressed, all log files will be exported to the attached device.
-  USB port is active, export in progress. Do not remove the connected USB drive during this state.
-  H-Genie® Lite in operation, export function is disabled.

There is a possibility to perform a calibration of the outlet pressure value by starting the calibration process  . Follow the instructions are shown during the process. The process should be performed during the annual maintenance.

- The Graph Screen  : displays H-Genie® Lite outlet pressure value in graph form over time.

- Help Screen ? : Displays information of a descriptive nature about how the H-Genie® Lite works, how to install and use it, and what to do if there's a problem. The Help Screen may be accessed from any screen and under any status. The touch screen language can also be changed here under the "Graphical User Interface" menu.

Status Bar: Displays the status of the H-Genie® Lite, the water (H_2O) level.

Figure 6: The Status Bar with connected USB drives

The status messages are:

- Initialize: Internal system check upon switching on.
- Ready: Ready to start generating hydrogen
- Preparation: Building hydrogen
- Running: Producing hydrogen
- Shutting down: Releasing internally stored hydrogen and shutting down the system.
- Emergency shutdown: Releasing hydrogen and shutting down after an emergency event is triggered.
- Calibration: setting the zero value of the outlet pressure

3. H-Genie® Lite Safety Features

The H-Genie® Lite has the following safety features to ensure safe and reliable operation:

1. The H-Genie® Lite is equipped with an internal hydrogen sensor, so in the unlikely event of a hydrogen leak the system will automatically shut down.
2. If the H-Genie® Lite cannot generate hydrogen pressure internally, then the system will automatically go into emergency shutdown mode.
3. Water leak detection.
4. The flow of air inside the H-Genie® Lite is enforced using 2 fans to ensure that the temperature inside the unit does not rise excessively and to prevent any build of hydrogen or oxygen in the event of a leak.
5. Upon power-up the H-Genie® Lite performs a self-check for internal leaks.
6. The hydrogen pressure inside the generator should only reach a maximum of 95 bar (1378 psi) and this is controlled electronically via a pressure sensor and mechanically using a pressure relief valve (Fail Safe).
7. There is a water level detector to ensure that the cell never runs dry.
8. Water separator malfunctions are checked to avoid high water content in the high-pressure system.
9. Water purity is checked to avoid the degradation of the electrolytic cell.
10. When the H-Genie® Lite is in emergency status the following occurs:
    a. The current to the cell is stopped.
    b. The internally stored hydrogen is evacuated into the fume hood.
    c. An audible and visual alarm will be heard.

4. Installation

4.1 Delivery Content

The H-Genie® Lite delivery package includes the following items:

1 pc of H-Genie® Lite - Generator	_____	☐
1 pc of Emergency Button and cable		☐
1 pc of Metal water tank cap		☐
1 pc of oxygen vent fitting		☐
1 pc of water vent outlet tube (10mm OD)	**2m length**	☐
1 pc of oxygen gas outlet tube (10mm OD)	**2m length**	☐
1 pc of H-Genie® Lite User Manual		☐
1 pc of Declaration of Conformity		☐
1 pc of power cable – check type	**EU** ☐ **UK** ☐ **CH** ☐ **USA** ☐	☐

Please ensure that all of the items listed above are present in the delivery package.

Additional pack of items could be ordered separately.

2 pcs of ss 1/8" tube, 0.1m and 1m lengths	☐
2 pcs of ss 1/8” nuts with ferrules	☐
1 pc of ss 1/8” to 1/16” reducer	☐
1 pc of ss 1/16” tube (1m length)	☐
2 pcs of ss 1/16” nuts with ferrules	☐
1 pc of Vici PEEK finger tight 1/16” nut	☐
1 pc of Water purifier cartridge	☐
1 pc of balloon filler assembly	☐

Check for any visible damage to H-Genie® Lite components. Should any item be missing or any parts visibly damaged, please contact your nearest ThalesNano Energy representative or service@thsenergy.com.

4.2 Location

- The H-Genie® Lite **must** be located on a flat, level surface inside a fully functional ventilated cabinet or ventilated area, such as a fume hood. This minimizes any risk related to a hydrogen leak into the environment.
- The fume hood or ventilated cabinet must be equipped with a standard electrical socket and a water hole.
- The oxygen and hydrogen vent tube outlets should be positioned as far apart as possible within the fume hood.
- It is recommended that any objects be placed a minimum of 15 cm away from the rear and the sides of the H-Genie® Lite to avoid any obstruction to the airflow in the cabinet and to allow any warm air from within the generator to be released freely into the environment. Ensure that none of the rear vents are obstructed. Failure to ensure this may result in damage to the H-Genie® Lite.
- Dimensions of the H-Genie® Lite can be found in the Technical Data section.
- Please adhere to the below operating temperatures:
    - Minimum Operating Ambient Temperature: 10 °C (50 °F)
    - Recommended Max. Operating Ambient Temperature: 30 °C (86 °F)

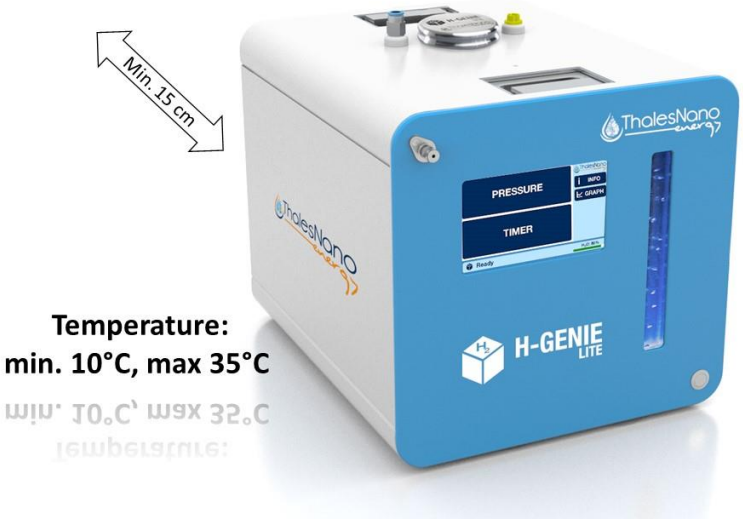

Figure 7: Operating requirements

4.3 Installing the H-Genie® Lite

Open the packaging and remove all the contents.

4.3.1. Place the H-Genie® Lite reactor box inside the selected fume hood cabinet.

4.3.2. Remove the water reservoir cap and fill the water reservoir with high-purity de-ionized water. Reattach the reservoir cup.

Figure 8: Water reservoir caps

Attention

The H-Genie® Lite generates hydrogen through in-situ water electrolysis. The operation of high-pressure cells requires high purity, de-ionized water. Millipore Milli-Q®: <1µS/cm is a must!!!

Using low quality water can cause irreparable damage of the instrument.

The volume of the water reservoir is an approx. 3500 mL. Take care not to overfill. During filling, the H-Genie® Lite indicates that it is full via two short beeps.

Ensure the water tank is topped up before using H-Genie® Lite.

4.3.3. Remove the yellow plug from the oxygen outlet port using a flat-headed screwdriver. Screw the oxygen line adapter into the hole. Attach the oxygen gas outlet tube to the outlet at the top of the H-Genie® Lite. Ensure the other end is attached to the rear of the fume hood cabinet to ensure the tube does not move when oxygen gas is released.

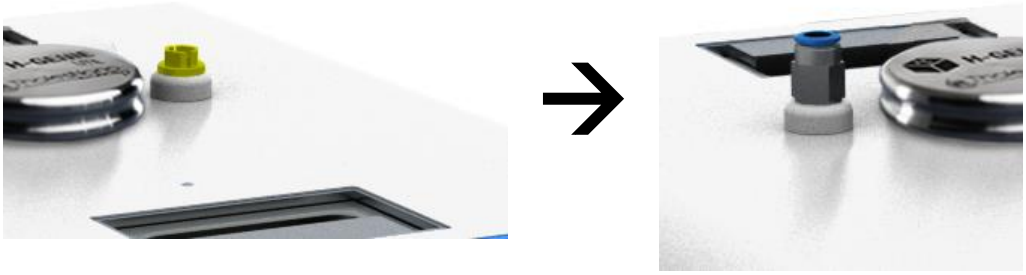

Figure 9: Remove the yellow plug and screw the oxygen line adapter in place

Do not impede or block the oxygen gas outlet at the top of the water reservoir while the machine is switched on. Only use the cap provided with the machine.

4.3.4. Connect one end of the water gas outlet tube to the water drain outlet and the other end to a sink or a wastewater receptacle located in the fume hood. Turn the blue switch to open and watch the water flowing out of the H-Genie® Lite. Pay particular attention to the bubbles in the water stream. Wait until no more air bubbles appear in the water stream (this may take a minute) and then close the blue valve switch. Take the tube out of the water drain outlet and place it in the water vent outlet. **Please ensure the open end of this tube is fastened to avoid movement when hydrogen gas is released.** Top up the water tank.

Do not attempt to drain any of the water tank unless the H-Genie® Lite is switched off.

Figure 10: Attached oxygen vent and water vent tubes.
Use water drain port with tubing from water vent if needed

Important! The water vent tube will release hydrogen into the fume hood. Please ensure that the ends of these pipes are at least 1.5m away from the outlet of the oxygen outlet to ensure hydrogen and oxygen do not mix or, if possible, in separate fume hoods.

4.3.5. Attach the emergency stop button to the connector at the rear of the H-Genie® Lite and ensure that the button is located in an easily accessible place.

4.3.6. Make sure to switch the rear main power switch to the „0" (off) position before inserting the power cable into the rear of the H-Genie® Lite. Connect the power cable to the mains power supply as well.

The electric cables must be guarded against moisture.

5. Performing a reaction with the H-Genie® Lite

Safety instructions:

During use the fume hood MUST be switched on, and the fume hood sash pulled down.

The H-Genie® Lite generates hydrogen internally. In normal operation, hydrogen will be released from the rear ports. It is essential that adequate precautions are taken to allow this to be safely ventilated by a fume hood cabinet.

Ensure that the reactor vessel is connected to the H-Genie® Lite and gas tight. Check to ensure that there are no leaks.

Please ensure the water reservoir is topped up at all times. It is vital that the electrolysis cell membrane is kept constantly wet. The cell must not be allowed to run dry or the cell will immediately and irreversibly cease to function.

Once the installation is complete, switch the main power switch, located at the rear of the H-Genie® Lite to the „I" (on) position. Wait while the Switch on/off button, located on the front of the instrument, lights up.
Switch on the equipment by pushing the Switch on/off button. When the initialisation process is ready to start the following screen will appear. Press „OK" to begin the H-Genie® Lite's selftest.

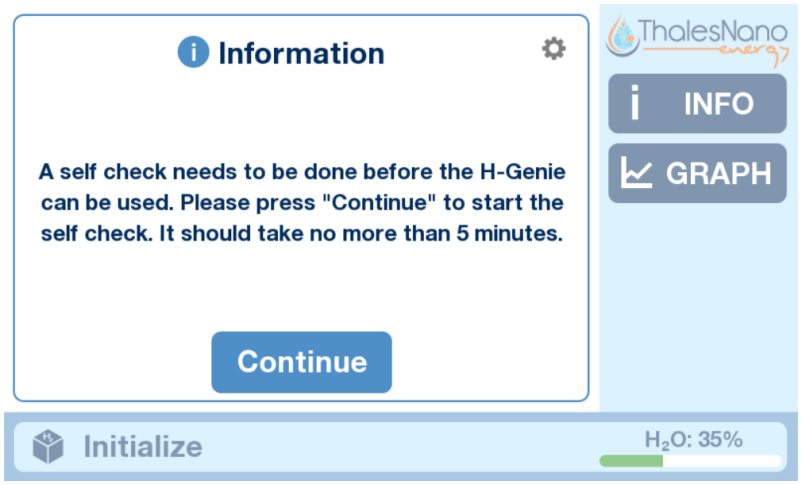

Figure 11: Self-test is ready to start

The screen will then change to the following, while the system will run through a self-test in order to check that the internal H-Genie® Lite hydrogen system can build pressure to the maximum settable limit. Do not switch the H-Genie® Lite off while the system is initializing. During this time a small amount of hydrogen may sporadically release. This is normal. The self-test may last as long as 5 minutes.

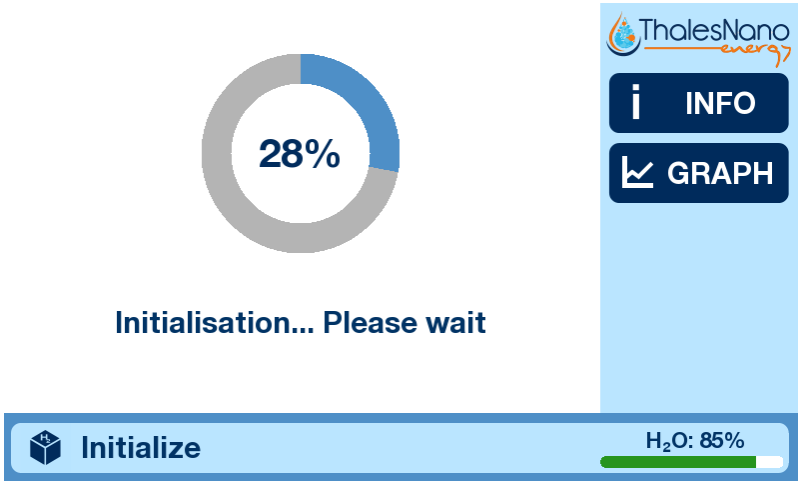

Figure 12: Initialization screen and Ready screen.

Once the system has finished the selftest and the initializing, the main screen will appear and the term „Ready" will appear in the status bar. You're ready to get started.

Please note!

During hydrogen production, the H-Genie® Lite will, from time to time, release the water extracted from the hydrogen gas out the back of the system. A small amount of hydrogen may also be released and make a noise. This is completely normal and you shouldn't be alarmed.

- The H-Genie® Lite is designed to run on a single tank of water for a minimum of 8 hours at maximum consumption. Before running out of water the below warning screen will appear. Once the water level of the H-Genie® Lite reaches the critical level, an error message will appear and the H-Genie® Lite will shut down to ensure the hydrogen generation cell is not harmed.

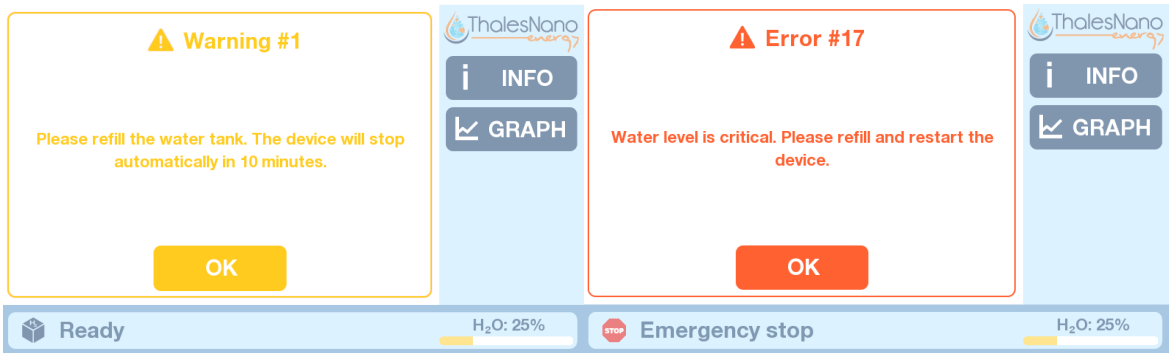

Figure 13: Warning and Emergency stop low water tank messages

Please note!

The H-Genie® Lite is designed to fill unpressurized vessels only.

5.1 Using PRESSURE mode

5.1.1 Connect your batch reactor to the front of the H-Genie® Lite using the appropriate tube and connection. Ensure there are no leaks and connections are tight.

5.1.2 Press the PRESSURE function on the main screen.

Figure 14: Main Screen

5.1.3 Press the meter to enter a reaction pressure. Press OK after you have set the appropriate value.

Figure 15: Pressure mode ready to start

5.1.4 Once the pressure parameter has been set, then press START. The H-Genie® Lite will now start filling up the batch reactor with hydrogen. The “Actual” value will start to rise and indicate the external pressure. If this number does not rise or rises extremely slowly (when taking into account the reactor size and gas flow rate), then check both the tubing and reactor for leaks.

5.1.5 Once the reactor reaches the set pressure, then the H-Genie® Lite will stop generating hydrogen and close the output valve. In parallel, the internal hydrogen is released.

5.1.6 Using the “Keep” switch means that once the reactor reaches the set pressure, then the H-Genie® Lite will stop generating hydrogen and wait. If a fall in pressure is detected (i.e. because of the consumption of hydrogen in the reaction) then more hydrogen will be generated.

5.1.7 Once the reaction is completed or you have no more need of the H-Genie® Lite, then STOP the H-Genie® Lite.

Please note!

Never disconnect the H-Genie® Lite from the reactor while the reactor or tubing is under pressure or the H-Genie® Lite is still running.

Please note!

Do not restart the H-Genie® Lite during an ongoing reaction.

5.2 Using TIMER Mode

In Timer mode, the pressure is limited to 5 bar.

5.2.1 Press the TIMER function on the main screen.

Figure 16: Main Screen

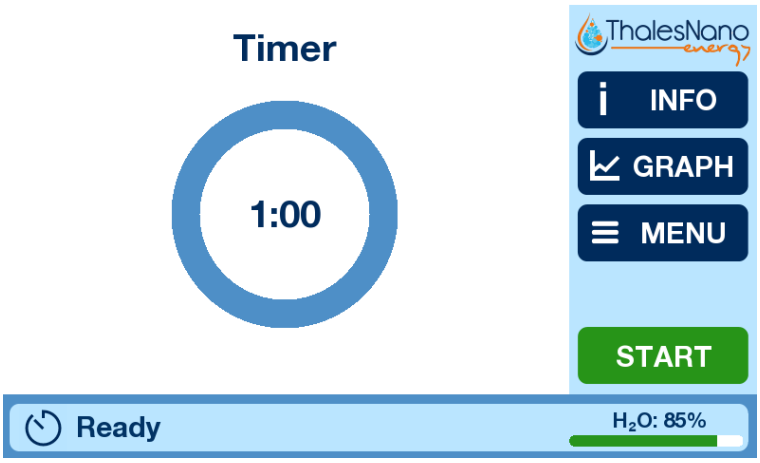

Figure 17: Balloon mode ready to start

5.2.2 Press the timer circle to enter a time.

5.2.3 Press OK after you have set the appropriate value.

5.2.4 Connect your balloon via a tube to the front of the H-Genie® Lite. Ensure no leaks.

5.2.5 Once all the parameters have been set, then press START.

5.3 Visualize Experimental Data – Graph screen

Pressing the GRAPH symbol on the Main menu opens the graph screen.

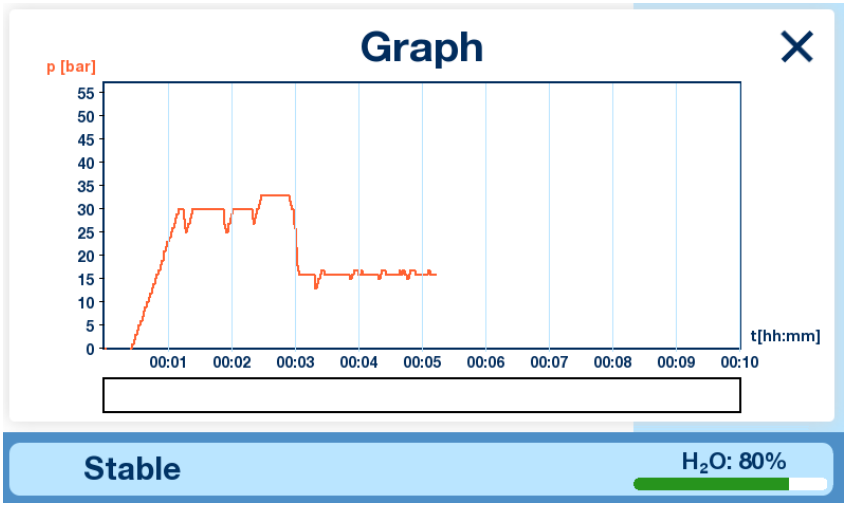

Figure 18: The Graph screen

The graph screen will display the output pressure (bar) data over time during the filling process.

5.4 Turning off and shutting down the H-Genie® Lite

To turn off/shutdown the H-Genie® Lite. Press the “On/off button” on the front of the system.

Figure 19. Shutdown button

The H-Genie® Lite will now start to shutdown. If there is any internal hydrogen present, then it will be released out the back and through the water vent. This will make a noise, but do not be alarmed, this is completely normal. The entire procedure takes ~60 seconds.

Please note! If you intend to switch back on the instrument straight away after shutting down, then please wait a minimum of 30 seconds before switching on.

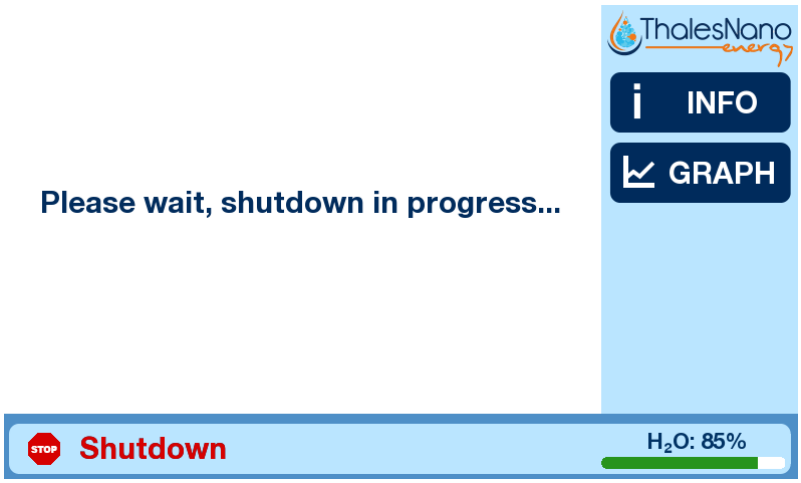

Figure 20: Shutdown phases.

The same procedure will take place if the emergency button is pressed or the software triggers an emergency shutdown, such as if there is a cell failure or hydrogen leak detected. The below screens will appear.

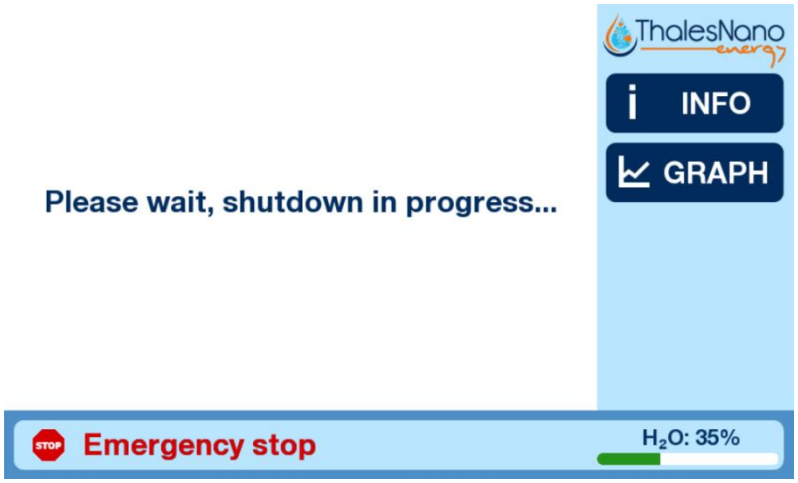

Figure 21: Emergency shutdown phases.

6. Firmware & Software Update

If your system is under warranty, then your H-Genie® Lite will be eligible to receive new software and firmware when they are released. To do so, some preparation steps are needed from your side.

- Firmware update: copy the Master.hex file on a freshly formatted USB stick
- Software update: copy the software parts on a freshly formatted USB stick

Both, software and firmware can be updated parallel by the following steps:

- Make sure the rear main switch of the H-Genie® Lite is in the off position.
- Attach the USB stick to the back of the H-Genie® Lite.
- Switch on the main switch and wait for the screen to show the “Updater” menu.
- Active icons show the items will be updated
- Click anywhere on the screen to run sequentially all the updates from the USB stick
- Wait for the update to finish.
- Turn of the equipment and remove the USB from the back.

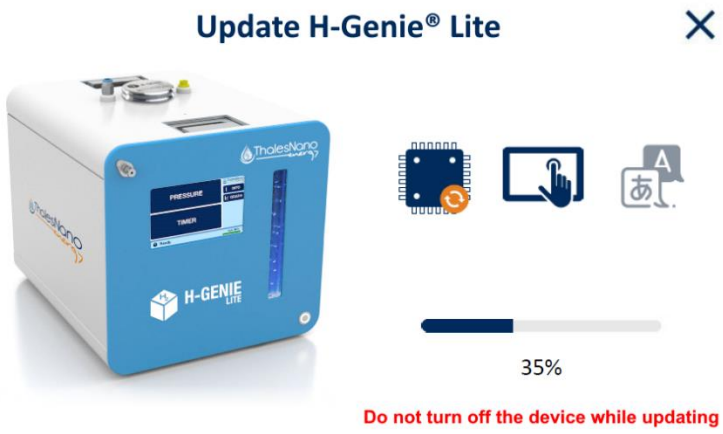

Figure 22: Update screen

7. Troubleshooting

Error messages	
Error Codes	***Descriptions***
Error #0	The emergency stop button is activated or not connected to the equipment.
Error #3	Pressure sensor error, please contact service.
Error #4	The hydrogen sensor is not working properly, please contact service.
Error #8	The mechanical water separator is saturated, restart the machine. If this does not help, please contact service.
Error #9	The mechanical water separator is not working properly, please contact service.
Error #10	Box fan is not operating properly, please contact service.
Error #13	Heat exchanger fan is not working properly, please contact service.
Error #14	Pressure sensor value out of range, please contact service.
Error #16	The water conductivity is too high. Drain the water from the tank and refill with water of the right quality (<1µS/cm)
Error #17	The water tank level is critically low, fill the tank and restart the machine.
Error #18	The hydrogen cell may not be working properly, please contact service.
Error #19	The flow rate in the water circuit is low, which may be the result of the presence of air bubbles in the water circuit. If the machine has been deaired and the error persists, please contact service.
Error #20	The ambient H2 concentration exceeded 1%. Check the area where the machine is located. If the error persists without any visible reason, please contact service.
Error #21	A communication error has occurred between the GUI and the controller. Restart the machine. If this did not help, please contact service.
Error #22	System pressure too high, please contact service.
Error #24	There is a calibration error on the machine. Please restart the machine, enter the “Info” menu and run a calibration process following the instructions.
Error #25	The cell in the machine has overheated. Please turn off the machine and restart it after 10 minutes. If the problem persists, please contact service.
Error #26	The pressure transmitter needs to be calibrated, please contact service.
Error #28	There were signs of leakage during initialization. Please restart the machine. If the problem persists, please contact service.
Error #30	Communication between the electrolysis cell power supply and the controller has been interrupted, restart the machine.
Error #31	The emergency circuit is active, restart the machine.

Warning messages	
Warning codes	***Descriptions***
Warning #1	The water level in the tank is low and the machine will stop automatically after 10 minutes. If you want to avoid this, fill the tank.
Warning #2	The conductivity of the water filled into the tank of the machine is> 1 µ S / cm. If the built-in resin cannot reduce this and it lasts for >30 minutes, the machine will stop.
Warning #3	The temperature of the water in the machine's tank has exceeded 50 ° C.
Warning #4	The ambient H2 concentration exceeded 0.5%.
Warning #5	The machine has not yet been calibrated, go to the “Cal” submenu of the “Info” menu and follow the instructions.
Warning #6	Cell stack voltage measurement data is false.
Warning #7	The internal temperature of the box is > 30 ° C, which may affect its gas purity.

If you are experiencing problems with the H-Genie® Lite and a service engineer is required, please e-mail a short description of the problem, along with your contact details, to the following address: service@thsenergy.com.

We will try and respond within 24 hours on work days.

8. Maintenance Checks

8.1 Daily Maintenance Checks

Opening of the H-Genie® Lite reactor box, and any necessary repairs can only be performed by ThalesNano Energy service personnel or qualified persons. Unauthorized opening of the device will render the warranty null and void.

Ensure you check the following on a daily basis.

- Top up the water tank
- Ensure all tube connections and fittings are intact and secure
- There is no water spillage or leaks around the device.
- The touch screen and other surfaces are clean and free of chemicals.
- Check the purity of the water on the Info Screen

8.2 Using the right Water Purifier Cartridge

In order to maintain water purity at an acceptable level to ensure a good hydrogen cell longevity, then it is mandatory to use a Water Purifier Cartridge. The Water Purifier Cartridge should be changed every 3 months (if you use <1 µS/cm quality water). Water Purifier Cartridges can be ordered directly from ThalesNano Energy. Contact info@thalesnanoenergy.com for ordering information.

Warning!

Do not use your own resin as a water purifier. Only use official ThalesNano Energy certified products. Failure to do so will invalidate product warranty immediately.

8.3 Changing a Water Purifier Cartridge

The following steps will take you through how to change Water Purifier Cartridge.

8.3.1 Switch off the equipment. Make sure that the main power switch is in the “0” position.

8.3.2 Drain the water from the equipment.

8.3.3 Open up the Cartridge holder unit by turning the transparent cap counter clockwise. Some remaining water may flow out from the holder.

8.3.4 Remove the used Water Purifier Cartridge.

8.3.5 Insert a new Water Purifier Cartridge.

8.3.6 Mount the transparent cap by turning it in a clockwise direction.

8.3.7 Fill the water tank with the recommended quality water.

8.3.8 Check the integrity of the holder unit.

8.3.9 Connect one end of the water vent outlet tube to the water drain outlet and the other end to a sink or a wastewater receptacle located in the fume hood. Turn the blue switch to open and watch the water flowing out of the H-Genie® Lite. Pay particular attention to the bubbles in the water stream. Wait until no more air bubbles appear in the water stream (this may take a minute) and then close the blue switch. Take the tube out of the water drain outlet and place it in the water vent outlet. Please ensure the open end of this tube is fastened to avoid movement when hydrogen gas is released. Top up the water tank.

Figure 23: Location of Water Purifier Cartridge

Once the Water Purifier Cartridge has expired, then make sure the ion exchange resin is disposed of as per your institute's regulations.

For a list of up to date accessories, please visit www.thalesnanoenergy.com or contact sales@thalesnanoenergy.com.

9. Technical Data

Pressure Range of H-Genie® Lite:	From ambient to 50 bar (gauge)
Internal hydrogens pressure limit:	95 bar
Hydrogen flow rate range:	Approximately 1200 NmL/min*
Water purity at room temperature:	99.9% (3.0)
Internal hydrogen volume:	64 mL
Water consumption rate:	~ 200 cm^3/h
Water reservoir capacity:	Internal: 3L
Recommended environment:	Ventilated laboratory fume hood
Power requirements:	Mains: 100V to 240V AC, 47-63Hz
Power consumption:	max. 600 VA
Unit dimensions (H x W x D):	385 mm x 365 mm x 476 mm
Unit weight:	34 kg (with empty wate reservoir)
Outlet parameter:	Tubing OD: 1/8” The output valve can accept any connector with a male thread Press 1/8”

Figure 24: H-Genie® Lite dimensions

*Performance depends on the age and use time of the cell.

10. Warranty Information

The H-Genie® Lite is delivered in accordance with ThalesNano Energy standard terms and conditions is also available on request.

The warranty period of the H-Genie® Lite is 12 months, starting from the date of delivery to the client. Operation inconsistent with the manufacturer's instructions is excluded from the warranty, while the unauthorized opening of the device will render the warranty null and void.

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If we find a defect covered by the warranty, repair or replacement, at our discretion, will be carried out free of charge. Packing and transport costs are borne by the customer.